US-PAT-NO: 6113578

DOCUMENT-IDENTIFIER: US 6113578 A

TITLE: Optical dose measurements in syringes

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Typically, these injections are performed using disposable syringes. Unfortunately, no adequate apparatus exists that measures and electronically
records dose information from a disposable syringe. As a result, the patient or health care worker performing the injection is burdened with the task of injecting the dose and then manually recording the dose amount in a log book.

The recorder described by Beckers does not automatically measure and record
dose information from a disposable syringe. After injecting a dose, the patient must manually enter the dose information into the recorder using switches or keys. Although this is an improvement over keeping written records
on paper, the effectiveness of the drug program is still limited by the patient's recollections and recordings, which are unreliable.

Although the syringe pump described by Sanderson does allow electronic recording of dose information, it is only designed to deliver medication directly into an intravenous line. It is not designed to inject a patient directly nor can it measure and record a dose from a syringe unless the syringe
pump pushes the plunger. Consequently, the syringe pump is of little use to a
health care worker who must inject a patient directly, or to an outpatient

who
must follow a self-injection treatment program.

Although the injection pen described by Muller measures and electronically records dose information, it has several disadvantages that have precluded its
widespread use. The injection pen is an expensive device requiring complicated
electronic equipment to deliver and record doses. Moreover, because the injection pen integrates a syringe and electronic recorder into one device, it is not disposable. The patient must use it repeatedly for each injection, even after the injection pen has been contaminated with blood. Consequently, the
injection pen does not provide an inexpensive, convenient, or hygienic solution
to patients wishing to measure and electronically record injected dose information.

Operating the device described by Ronald Claeys requires many complicated steps
of weighing syringes, scanning in bar codes, etc. The complexity of the required procedures as well as the high cost of the apparatus have precluded its widespread use. Additionally, the device cannot be easily carried by the user for recording doses while away from the health care facility or home. Thus, no inexpensive apparatus exists for determining and electronically recording dose information from a disposable syringe. Further, no such apparatus exists that is both simple in operation and easily carried by a user.

If the detector detects light transmitted or emitted by the syringe, the detector is situated opposite the light source relative to the syringe. If the detector detects light reflected by the syringe, the detector is situated adjacent the light source relative to the syringe (on the same side of the syringe).

FIG. 1-B illustrates generally the principal detection step performed by an apparatus of the present invention. Light (electromagnetic radiation) is incident on syringe 22 and interacts with syringe 22. Light resulting from

the
interaction is then incident on a detector. The light incident on the detector may generally be light transmitted, reflected, and/or emitted by syringe 22. In general, two elements of syringe 22 may vary with the quantity of liquid within syringe 22 in a typical dose administration sequence: the position of the syringe plunger (relative to the syringe barrel), and the quantity/position of the liquid within syringe 22. Light incident on syringe 22 may interact with the plunger and/or liquid. The measured light interaction with the plunger is preferably substantially different from the interaction with the liquid, such that the interaction with syringe 22 as a whole depends on at least one of the position of the plunger and the quantity of liquid.

FIG. 4 shows a perspective view of another alternative embodiment of the present invention. An apparatus 420 comprises a holding means 452 for holding
the barrel of a syringe 480 in an predetermined position relative to a measurement window 403. Syringe 480 comprises a plunger 490 having a longitudinally-varying marking 491. Marking 491 is desirably a color marking,
but generally may be a shape marking. A light source and detector are situated
behind measurement window 403, for reading the part of marking 491 in front of
window 403. Light emitted by the light source is reflected by marking 491 back
into the detector. The reflected light (its intensity and/or spatial distribution) is indicative of the position of marking 491 relative to window 403, which is in turn indicative of the quantity of liquid within syringe 480.

The method does not require the presence of a plunger to transmit, reflect or absorb light. A method of the present invention may be used to optically measure liquid levels in plungerless syringes operated using air pressure, for example.